OFFICE OF
BUILDING TECHNOLOGY,
STATE AND COMMUNITY PROGRAMS

Energy Code Development for Cooling Climates

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Outline

- **Background**
- Economic Evaluation of Codes
- What Codes Do Now
- What PNNL and Others Are Considering
- Recommendations and Conclusion

Assertion: When residential cooling is discussed in codes, the focus is on glazing.

Yes, there are implications for wall and roof insulation and radiant barriers, (and roof color and thermal mass, etc), but the big issue is glazing.

The Big Problem with Glazing

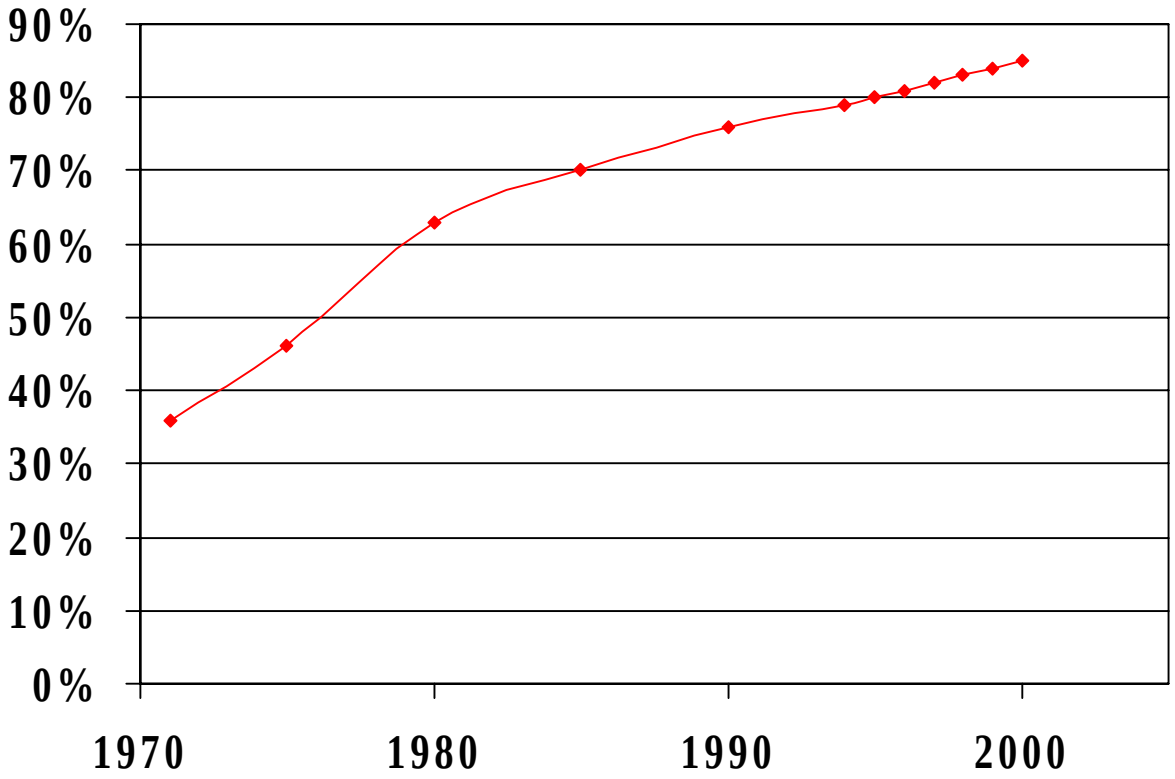
- Windows aren’t thermally as good as walls
- Windows let in sun which increases the thermal load
- But people want big windows and sun rooms so they can see out and let the light in.
- And people want clear windows so they get a good view

Problem Restated

What people want is in more or less direct conflict with energy efficiency concerns.

Where should the codes set the balance?

Percentage of New Homes with Air Conditioning



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Economic Evaluations

- It is not clear that strict economic evaluation forms the basis of any current residential codes
- Virtually all economic evaluation of energy codes that PNNL performs is done after the energy code is developed and before the code is adopted by states.
- Exceptions
  - First cost comparisons to show that proposal saves money or raises cost
  - ASHRAE Standard 90.1-1999 envelope and HVAC

Economic Evaluations

- PNNL uses life cycle costing in our evaluations.
- In addition to the problems associated with determining actual costs, there are lots of disagreements on economic parameters such as interest rates, cost escalation rates, life of measures, and fuel costs. (See ASHRAE 90.1)
- First cost analysis is certainly simpler but tends to lead to minimal energy savings in the long run.

Insight from Past Residential Analyses

- Current codes tend to reflect current practice from the 80's and 90's.
- Current codes tend to be
  - cost-effective (energy savings pay for energy efficiency enhancements)
  - but not optimal in terms of energy efficiency (there is certainly room for improvement)
  - And not necessarily as cost-effective as they could be

Analyses of Cooling Loads

- Optimal window area in most climates is ZERO. This is not surprising.
  - In cold climates, windows just aren't as good as walls.
  - In hot climates, windows let in a lot of solar gain
  - In some hot, sunny climates (Denver, Albuquerque), windows may be a new gain if properly designed

SHGC Requirements Tough To Analyze

- It is virtually impossible to compare a SHGC of 0.40 with one of 0.35 and 0.30 due to problems associated with assigning product costs to slightly varying levels of SHGC
- Cost differential depends on manufacturer and product line, and glazing type. Differential may be zero or significant.

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Residential Climate Dependency in Various National Codes

- ASHRAE 90-75 HDD65
- ASHRAE MCEC HDD65
- ASHRAE 90-80 HDD65
- MEC 83 HDD65
- MEC 86 HDD65
- MEC 89 HDD65
- MEC 92 HDD65
- MEC 93 HDD65
- ASHRAE 90.2 HDD65, CDH74
- MEC 95 HDD65
- IECC 98 HDD65
- IECC 00 HDD65
- IECC 01 HDD65

Except for ASHRAE 90.2, no climate parameters other than HDD65 are needed.

Residential Glazing Requirements in Various National Codes

- ASHRAE 90-75 *
- ASHRAE MCEC *
- ASHRAE 90-80 *
- MEC 83 *
- MEC 86 *
- MEC 89 *
- MEC 92 *

"*" indicates glazing requirement is part of overall wall requirement

- MEC 93 *
- ASHRAE 90.2 U-factor, SC
- MEC 95 *
- IECC 98 U-factor, SHGC
- IECC 00 U-factor, SHGC
- IECC 01 U-factor, SHGC

Until recently, most codes just treated glazing as part of the wall.

Hawaii Example

- Residential code assumes no heating at all.
- Requirements based on Relative Solar Heat Gain criteria, as a function of WWR and orientation. (This is basically an SHGC requirement)
- Criteria can be satisfied by combination of fixed shading devices, tinted or reflective glass, and interior or exterior shading devices.

Florida Example

- Glazing u-factor, solar heat gain coefficient, overhangs, and orientation are all taken into account.
- Requirements are function of climate

The Commercial Example

- Current ASHRAE 90.1-1999 requirements are expressed in terms of HDD65 and CDD50.
- Glazing requirements include U-factor as a function of percent glazing, orientation dependent SHGC, and credit for permanent overhangs
- Trade-off mechanism takes into account CDD65, CDH80, and various solar parameters

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What's PNNL Looking At?

- Keeping roughly same stringency
- Proposing potential tradeoffs for overhangs
- Proposing potential tradeoffs for low WWR
- Proposing annual energy cost for compliance metric in Chapter 4

Note that these items DO NOT decrease cooling loads – they only make it easier to comply

Want to Decrease Residential Cooling Loads Via Codes?

- Increase equipment efficiency
  - But this is covered at national level
- Require better duct construction
  - But this is already in code even if not accomplished
- Limit lighting and other internal gains
  - But these are not typically regulated for homes
- Increase envelope insulation
  - But this has little impact on cooling

Want to Decrease Residential Cooling Loads Via Codes?

- Require light colored or reflective roofs
  - But this impacts the appearance of the home
- Require thermal mass
  - But this eliminates many traditional stick-built homes

- All this leaves solar gain as the only realistic thing to address
  - And even that is bound to be controversial

Solar Gain Reduction

- Penalize bad solar orientation
  - Likely to be controversial to tell people which way to face their house and windows
- Penalize window area
  - But people like big windows. Of course, window area is already penalized for conduction purposes
- Require shading devices
  - But this changes appearance of house and can be costly
- Require low SHGC
  - But people like clear views. This is in the code now.

What are Others Looking At?

- Additional steps of SHGC requirement rather than a “no requirement” to “0.40”
  - More steps, more complexity, more savings?
- Eliminating or modifying requirement for HDD>3000.
  - Do savings justify requirement above this level?
- Extending “0.40” requirement to higher HDD.
  - manufacturer who figures it will increase market share

Recommendation

- Good option: Keep “simple” requirements in IECC/IRC and develop “simple” tradeoffs that allow some flexibility

- Best option would be use of a Chapter 4 tradeoff based on annual energy cost and possibly a lower window-to-floor area baseline (12% as opposed to 18%)

Conclusion

- Something is being done about residential cooling in the energy codes
- But more could be done to offer a choice of how to meet the requirements